What physical activity surveillance needs: validity of a single-item questionnaire

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Abstract: BACKGROUND: Self-report instruments to assess physical activity are still the most feasible option in many population-wide surveys, and often need to be very short owing to resource constraints. The aim of this study was to test the criterion validity of a single-item physical activity measure using accelerometers and to compare its measurement properties by gender, age group (including older adults) and language region. METHODS: A validation study was carried out within the second follow-up of a large Swiss cohort study (Swiss Cohort Study on Air Pollution and Lung and Heart Disease in Adults, SAPALDIA, n=208) and included an additional convenient sample (n=110). Participants wore an accelerometer over eight consecutive days and then completed the single-item measure. Spearman's rank-order correlations were used to assess the criterion validity. RESULTS: Physical activity levels were higher in men, younger individuals and those from the German-speaking part of Switzerland. Correlation coefficients for the number of days with at least 30 min of moderate-to-vigorous physical activity according to the single item and different accelerometer activity outcomes ranged from 0.40 to 0.54. Correlations were higher for women, younger individuals and participants from the French-speaking and the Italian-speaking parts. CONCLUSIONS: The single-item physical activity measure performed at least as well as other physical activity questionnaires. The differences in criterion validity between sub groups indicate that factors such as gender and age should be taken into account when developing physical activity questionnaires and in future validation studies.

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ABSTRACT

Background Self-report instruments to assess physical activity are still the most feasible option in many population-wide surveys, and often need to be very short due to resource constraints. The aim of this study was to test the criterion validity of a single-item physical activity measure using accelerometers and to compare its measurement properties by gender, age group (including older adults) and language region.

Methods A validation study was carried out within the second follow-up of a large Swiss cohort study (Swiss Cohort Study on Air Pollution and Lung and Heart Disease in Adults, SAPALDIA, N=208) and included an additional convenient sample (N=110). Participants wore an accelerometer over 8 consecutive days and then completed the single-item measure. Spearman's rank-order correlations were used to assess the criterion validity.

Results Physical activity levels were higher in men, younger individuals and those from the German-speaking part of Switzerland. Correlation coefficients for the number of days with at least 30 minutes of moderate-to-vigorous physical activity according to the single item and different accelerometer activity outcomes ranged from 0.40 to 0.54. Correlations were higher for women, younger individuals and participants from the French- and the Italian-speaking parts.

Conclusions The single-item physical activity measure performed at least as well as other physical activity questionnaires. The differences in criterion validity between sub groups indicate that factors such as gender and age should be taken into account when developing physical activity questionnaires and in future validation studies.

INTRODUCTION

Measuring physical activity is a pre-requisite for understanding physical activity behaviour and behaviour changes in large populations. For monitoring and evaluation purposes assessing physical activity needs to be feasible and inexpensive. Even though objective assessment of physical activity has become more widespread during the last years,[1] limitations regarding costs, feasibility and organisational resources remain problematic, especially in large samples. Therefore, self-report measures are still popular because they can be easily administered and can be used in large populations at relatively low costs.[2]

Physical activity questionnaires vary greatly in length, as well as in the inclusion of different domains, intensities and categories of activities. Longer and more detailed questionnaires usually report higher physical activity levels than shorter ones,[3] perhaps because individuals are prompted to think about activities in more detail.

As physical inactivity is a leading risk factors for mortality [4-6] and acts as a mediator or moderator in many associations of interest in epidemiological studies, population-level assessment of activity levels needs to be integrated into a wide range of studies that cover a variety of disciplines, including health, nutrition, transport and sport. However, space is often limited and brief, simple and valid measures of "physical activity" are needed.

In older individuals, the assessment of self-reported physical activity is even more difficult.[7] Older adults spend more time performing low intensity activities and less performing moderate and high intensity activities compared to younger adults,[8] and lower intensity activities are more difficult to recall.[9] Furthermore, elderly people's activities may be more irregular as their days are less structured compared to the working population and therefore recall is made more difficult. Longer questionnaires can be problematic due to high cognitive demands and limited comprehensibility.[7] It may therefore have advantages to use short physical activity measures in older populations.

Several short physical activity questionnaires or single-item questions exist.[10] Their validity is moderate when compared to longer physical activity questionnaires with correlation coefficients varying greatly.[10] Furthermore, only few tools have been validated using objective measures of physical activity such as accelerometers.[11-13] These studies have shown weak to moderate correlations. Two of the first and commonly used single item measures are those asking about the activity level compared to peers and about the frequency of exercise-induced sweating in days per week. These have been shown to discriminate well between more and less active individuals based on resting heart rate, triceps skinfolds and physical activity as assessed by the Harvard Alumni Survey.[14]

Recently, a new single-item question has been developed for use in physical activity and related research.[10, 13] The item has been developed in English and covers the past week. It asks about the

number of days spent with at least 30 minutes of moderate-to-vigorous physical activity. Physical activity guidelines in Switzerland and other countries recommend at least 5 days of such activities per week. The reliability and validity of the single item question has been assessed, the latter one by comparing the single-item measure with the Global Physical Activity Questionnaire (GPAQ)[10] and with accelerometers in a smaller sample.[13] Concurrent validity (r=0.53) and criterion validity (r=0.46 to 0.57) were modest.[10, 13] The authors concluded that the single-item measure is a valid tool for physical activity assessment. However, criterion validity was tested in a relatively small volunteer sample of English-speaking University staff and students, and the need for further testing of the single-item measure in different population groups was highlighted.[13]

This study builds upon previous work with the aim to determine criterion validity of the single-item measure in a diverse sample of more than 300 adults aged 18-84 years living in three different language regions (German, French, Italian) of Switzerland, and to compare the measurement properties of the single-item physical activity question for men and women, for different age groups and for different language regions.

METHODS

Study design, procedure and participants

This study was part of the Swiss Cohort Study on Air Pollution and Lung and Heart Disease in Adults (SAPALDIA).[15, 16] Initially, almost 10,000 participants aged 18-61 years from the general population in eight regions were recruited at baseline in 1991. After a first follow-up in 2002/03,[15] the second follow-up took part in 2010/11. Physical activity assessment was introduced during the first follow-up using four short questions. In the second follow-up, the long version of the International Physical Activity Questionnaire (IPAQ) was introduced in addition, and in a sub sample of 208 participants the single-item question and accelerometers were used for validation purposes. The aim was to include at least 50-60 individuals in each age group and language region. The age range at the second follow-up was between 38-84 years. In order to include also younger age groups and to increase the number of individuals at higher ages in this study, an additional convenience sample was recruited via word-of-mouth advertising targeting individuals aged 18-40 and individuals aged >65 years.

SAPALDIA participants were invited to the study centres for physical assessment. The validation study involving accelerometers took place in a subsample in five of the eight study centres. At the centre visit, individuals were asked to participate in the validation study wearing an accelerometer for 8 days and completing the long IPAQ and the single-item question on the last day. Interested participants completed and returned a separate consent form and were contacted by telephone. Accelerometers, IPAQ and the single-item question were sent and returned by post. Similarly,

individuals recruited from the convenience sample were given instructions by telephone and they received and returned the material by post. The study was approved by the Ethics committees of the respective study regions.

Measurements

In the present study, the single-item physical activity question [10, 13] was translated into German, French and Italian (see online appendix). Translations were carried out according to the recommendations for the cultural adaptation of the IPAQ.[17] The wording of the original English version was: "In the past week, on how many days have you done a total of 30 minutes or more of physical activity, which was enough to raise your breathing rate? This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places, but should not include housework or physical activity that may be part of your job." The single-item measure was applied in a written, self-administered format.

ActiGraph GT3X accelerometers (ActiGraph, Pensacola, FL, USA) were used for objective physical activity assessment. An epoch time of 5 seconds was used which was re-integrated to 60s for analysis in order to comply with other studies in adults.[18] The software Actilife 5 was used to initialize accelerometers and download the data. The devices were attached to an elastic belt and individuals were instructed to wear them on the right hip during waking hours for eight consecutive days.

Gender, age, and language (German-, French- or Italian-speaking region) were assessed as well.

Statistical analyses

Accelerometer data were retrieved using Actilife 5 and cleaned and analysed using MeterPlus (Santech Inc., version 4.2, www.meterplussoftware.com). Data from the vertical axis were used. In order to classify accelerometer output data into different intensity categories, cut-offs were used as follows. Minutes per week spent in sedentary (<150 counts/minute),[19] light (150-2019 counts/min), moderate (≥2020 counts/min) and vigorous (≥5999 counts/minute) physical activity [20] were calculated as well as the number of steps per day. Time spent in moderate-to-vigorous activities included all minutes ≥2020 counts/minute. Non-wearing time was defined as 60 or more minutes of consecutive zeros. Furthermore, minutes spent in bouts of 10 or more minutes (allowing for two minutes below threshold) in moderate-to-vigorous physical activity were calculated. A day was defined as valid if at least 10 hours of data were recorded. In order to be included, individuals had to have seven valid days of accelerometer measurements. The reason for this rigorous inclusion criterion

was that the single-item measure assesses the number of days during the past week with at least 30 minutes of physical activity. For individuals with eight valid accelerometer days, the first day was omitted because it has been reported that physical activity was slightly higher on the first day of recording.[21]

Descriptive analyses were performed for the characteristics of the participants comparing men and women separately for SAPALDIA participants and participants from the convenience sample. To compare different physical activity variables by gender, age group and language region, non-parametric tests (Wilcoxon rank sum test to compare two groups, Kruskall Wallis test to compare three groups) were used due to the non-normal distribution of the data. Furthermore, Spearman's rank correlations were calculated in order to compare single-item and accelerometer data for the total population and for subgroups. The following accelerometer parameters were calculated in order to compare them to the single item data: total activity (counts/minute), steps/day, minutes per day spent in vigorous, moderate, and moderate-to-vigorous activities, the number of days spent with ≥30 minutes of moderate-to-vigorous activities, time spent in light activities, and sitting time. For time spent in moderate-to-vigorous activities, both total minutes and minutes spent in bouts of at least 10 minutes each were calculated and compared to single item data. Kappa statistics were used to compare the classification of participants as sufficiently active (achieving 30 minutes of moderate-to-vigorous activity on at least 5 days per week). For illustration purposes, a scatter plot with frequency weights and a linear regression line for the comparison of the single-item measure and accelerometer data was computed. To emphasize potential differences between the sub groups, graphs with linear regression lines were computed separately for subgroups.

RESULTS

Characteristics of the participants

Initially, 376 individuals agreed to participate in the validation study. Of these, 24 (6.4%) were excluded due to missing accelerometer data (individuals did not wear accelerometer or the device had a technical problem). A further 27 individuals (7.2%) were excluded due to missing single-item data (did not complete or return the single-item questionnaire) and 7 individuals (1.9%) because they had less than seven valid accelerometer days. The final sample included 318 (84.6%) individuals. Table 1 presents the characteristics of the participants. There were no differences between included and excluded participants regarding gender, age and language region (data not shown).

Table 1. Characteristics of participants

		SAPALDIA population				Convenience sample			
	Overall	All	Men	Women	p	All	Men	Women	p
N	318	208	97	111		110	49	61	
Gender, %			46.6	53.4			44.5	55.5	
Age (y), mean (SD)	54.7 (15.6)	57.6 (10.6)	58.3 (11.3)	57.0 (10.0)	0.39	49.1 (21.1)	52.7 (21.2)	46.2 (20.7)	0.11
Age category, N (%)									
18-39 y	54 (17.0)	7 (3.4)	4 (4.1)	3 (2.7)		47 (42.7)	17 (34.7)	30 (49.2)	
40-64 y	156 (49.1)	134 (64.4)	57 (58.8)	77 (69.4)		22 (20.0)	10 (20.4)	12 (19.7)	
≥65 y	108 (33.9)	67 (32.2)	36 (37.1)	31 (27.9)	0.28	41 (37.3)	22 (44.9)	19 (31.1)	0.26
Language region, N (%)									
German-speaking	131 (41.2)	74 (35.6)	43 (44.3)	31 (27.9)		57 (51.8)	29 (59.2)	28 (45.9)	
French-speaking	99 (31.1)	70 (33.6)	31 (32.0)	39 (35.1)		29 (26.4)	13 (26.5)	16 (26.2)	
Italian-speaking	88 (27.7)	64 (30.8)	23 (23.7)	41 (36.9)	*0.03*	24 (21.8)	7 (14.3)	17 (27.9)	0.20

Physical activity behaviour according to single-item measure and accelerometer data

According to table 2 and based on accelerometer data, men spent significantly more time in vigorous-intensity physical activity and in sedentary behaviour and significantly less time in light activities compared to women. Significant differences for all variables were found for the different age groups (more activity in youngest age group, more sedentary behaviour in youngest age group, less light activities in youngest age group, less mean wear time in oldest age group). Comparing language regions, individuals from the German-speaking region were significantly more active than individuals from the French- and the Italian-speaking parts, they also spent more time in sedentary activities but less time in light activities.

There were no significant differences in the number of active days reported in the single-item measure between men and women (table 2). However, there were significant differences regarding age group and language region: The highest number of active days was reported in the youngest age group and in German-speaking individuals, the lowest number of days in the middle-aged group and in French-speaking individuals.

While some patterns were similar for the single-item measure and for accelerometers (e.g. highest activity levels in the German-speaking part), others were not (e.g. lowest activity levels in the oldest age group according to accelerometer data, in the middle age group according to single-item measure).

Because accelerometer wear time was significantly lower in older individuals, time spent in different intensities of physical activity was also extrapolated to the mean wear time (14.9 hours/day) in order to account for these differences (data not shown). Results did not differ and therefore the results are presented without extrapolation (table 2).

Table 2. Physical activity behaviour according to single-item measure and accelerometers, stratified by gender, age group and language region

		Gender			Age groups				Language regions			
	All	Men	Women	p[a)]	18-39y	40-64y	≥65y	p[b)]	German	French	Italian	p[b)]
N	318	146	172		54	156	108		131	99	88	
Single-item measure												
days/week, mean (SD)	2.9 (2.3)	3.0 (2.3)	2.7 (2.2)	0.21	3.7 (2.0)	2.4 (2.2)	3.1 (2.3)	*<0.001*	3.4 (2.2)	2.4 (2.1)	2.6 (2.3)	*0.002*
sufficiently active[c)] (%)	27.4	30.8	24.4	0.20	40.7	21.8	28.7	*0.025*	35.9	18.2	25.0	*0.01*
Accelerometers												
Hours/day of wear time, mean (SD)	14.9 (1.2)	15.0 (1.4)	14.9 (1.1)	0.16	15.3 (0.9)	15.1 (1.3)	14.4 (1.2)	*<0.001*	15.1 (1.3)	14.7 (1.1)	15.0 (1.3)	0.26
Counts/min, mean (SD)	342 (144)	349 (148)	336 (140)	0.47	403 (139)	342 (146)	310 (133)	*<0.001*	362 (150)	324 (139)	332 (138)	0.09
Steps/day, mean (SD)	8764 (3453)	8733 (3328)	8790 (3566)	0.92	9811 (3122)	9080 (3512)	7783 (3311)	*<0.001*	9231 (3453)	8086 (3240)	8831 (3600)	0.052
Minutes/day of mvpa, mean (SD)	37.5 (26.8)	40.2 (27.2)	35.2 (26.3)	0.07	53.6 (25.6)	35.9 (26.7)	31.8 (24.5)	*<0.001*	42.7 (27.5)	33.4 (26.7)	34.3 (24.9)	*0.009*
Minutes/day of vigorous activity, mean (SD)	2.2 (5.5)	2.6 (5.6)	1.9 (5.5)	*0.02*	6.5 (8.4)	1.8 (5.1)	0.8 (2.6)	*<0.001*	3.0 (5.3)	1.5 (5.2)	1.9 (6.1)	*<0.001*
Minutes/day of moderate activity, mean (SD)	35.3 (24.5)	37.6 (25.4)	33.3 (23.7)	0.12	47.1 (22.2)	34.1 (24.7)	31.0 (23.8)	*<0.001*	39.7 (25.6)	31.9 (24.4)	32.4 (22.1)	*0.02*
Minutes/day of mvpa in bouts, mean (SD)	17.1 (19.6)	17.3 (21.1)	16.8 (18.3)	0.96	21.7 (16.9)	16.1 (20.6)	16.1 (19.2)	*0.006*	19.8 (20.1)	15.8 (20.0)	14.4 (17.9)	*0.02*
sufficiently active[c)] (total mvpa, %)	33.0	31.5	34.3	0.60	61.1	30.8	22.2	*<0.001*	42.8	18.2	35.2	*<0.001*
sufficiently active[c)] (bouts in mvpa, %)	6.6	5.5	7.6	0.46	9.3	5.1	7.4	0.53	6.9	6.1	6.8	0.97
Hours/day of light activities, mean (SD)	4.4 (1.3)	4.1 (1.2)	4.6 (1.3)	*<0.001*	3.9 (1.0)	4.7 (1.3)	4.2 (1.2)	*<0.001*	4.2 (1.2)	4.4 (1.3)	4.6 (1.3)	*0.02*
Hours/day of sitting, mean (SD)	9.9 (1.5)	10.2 (1.5)	9.7 (1.5)	*0.006*	10.5 (1.2)	9.9 (1.7)	9.7 (1.4)	*0.002*	10.2 (1.5)	9.8 (1.3)	9.8 (1.7)	0.12

[a)] based on Wilcoxon rank-sum test (continuous variables) or chi2-test (categorical variables)
[b)] based on Kruskal-Wallis equality-of-populations rank test (continuous variables) or chi2-test (categorical variables)
[c)] sufficiently active: at least 30 min/day on at least 5 days/week

Validity of the single-item measure and sub group comparisons

Table 3 presents the Spearman's rank correlation coefficients for the number of days with at least 30 minutes of moderate-to-vigorous physical activity assessed with the single-item measure and different accelerometer outputs. Moderate correlations were observed for most variables (between 0.26 and 0.62). Highest correlations were present for time spent in moderate-to-vigorous activities which represents those activities that are addressed in the single-item measure.

There were no correlations for minutes/day spent in light and sedentary activities except for adults aged ≥65 years where there was a correlation of 0.27 between single-item measure and time spent in light activities. In general, correlations were higher for women than for men, for younger individuals than for older ones, and for individuals from the French- and Italian-speaking part than from the German-speaking part.

Table 3. Validity (spearman correlations) of single-item measure (days/week) against accelerometers

Accelerometer outputs	All	Men	Women	18-39y	40-64y	≥65y	German	French	Italian
Total (counts/min)	0.53***	0.46***	0.59***	0.62***	0.51***	0.49***	0.43***	0.57***	0.53***
Steps/day	0.49***	0.45***	0.53***	0.52***	0.51***	0.49***	0.37***	0.58***	0.51***
Total mvpa activity (min/day)	0.54***	0.43***	0.61***	0.62***	0.55***	0.45***	0.39***	0.62***	0.57***
Vigorous (min/day)	0.40***	0.38***	0.40***	0.62***	0.38***	0.26**	0.28**	0.54***	0.29**
Moderate (min/day)	0.52***	0.41***	0.60***	0.55***	0.53***	0.45***	0.38***	0.60***	0.55***
mvpa (min/day in bouts)	0.53***	0.44***	0.60***	0.58***	0.58***	0.41***	0.44***	0.52***	0.59***
Days mvpa (≥30 min/d in total)	0.50***	0.38***	0.59***	0.60***	0.48***	0.44***	0.34***	0.60***	0.51***
Days mvpa (≥30min/d in bouts only)	0.50***	0.43***	0.56***	0.48***	0.58***	0.37***	0.39***	0.49***	0.59***
Light (min/day)	0.08	0.12	0.10	-0.06	0.12	0.27**	0.08	0.12	0.18
Sitting time (min/day)	-0.13*	-0.13	-0.16*	-0.04	-0.12	-0.24*	-0.22*	-0.07	-0.18

* p≤0.05, ** p≤0.01, *** p≤0.001

The comparison of "sufficiently active" categories according to physical activity guidelines with at least 30 minutes per day on at least 5 days per week [22] is presented in table 4. The smaller kappa statistics for being sufficiently active according to accelerometers based on bouts of moderate-to-vigorous physical activities is probably due to the small proportion of individuals adhering to this criterion (table 2).

Table 4. Validity (kappa statistics) of single-item measure (sufficiently active, at least 5 days with ≥30 min/day) against accelerometers

Accelerometer outputs	All	Men	Women	18-39y	40-64y	≥65y	German	French	Italian
Sufficiently active (total mvpa)	0.44***	0.31***	0.54***	0.40***	0.41***	0.44***	0.32***	0.59***	0.44***
Sufficiently active (only bouts in mvpa)	0.15***	0.06	0.24***	0.08	0.17**	0.16*	0.03	0.27***	0.28***

* p≤0.05, ** p≤0.01, *** p≤0.001

A scatter plot with frequency weights and a linear regression line for the comparison of the number of days with moderate-to-vigorous physical activity according to accelerometers and according to the single-item measure is displayed in Figure 1 (regression coefficient=0.47, p<0.001). Figure 2 shows the linear regression lines for the number of days reported in the single-item measure and the number of days with at least 30 minutes of moderate-to-vigorous physical activity recorded on the accelerometer by gender (2a), age group (2b), and language region (2c).

DISCUSSION

The single-item physical activity measure performed as well as other self-report physical activity measures when compared to objective accelerometer data in all sub groups. Furthermore, the correlations (between 0.40 and 0.54 when including all participants) were similar to those reported by Milton et al. for the English version of the single-item question when compared to GPAQ (0.53 when including all participants),[10] and to accelerometer data (0.46-0.57).[13] In contrast to Milton et al.,[13] kappa statistics were higher for total than for bouts of moderate-to-vigorous physical activity in our study. Compared to other studies using accelerometers to validate short physical activity measures, the single-item measure performed better. For example, a kappa statistic of between 0.14 and 0.40 was found in a small Australian study.[11] A larger Australian study reported correlation coefficients between 0.20 and 0.39 for different accelerometer activity outputs for a short questionnaire including both frequency and time spent in physical activity .[12]

Our study also provides some validation evidence for the number of days of activity, without a total measure of volume, and still provides good levels of agreement with accelerometer data with the proportion meeting the physical activity recommendations.

According to a systematic review on measurement properties of (mostly longer) physical activity questionnaires, only few questionnaires performed as well as or better than the single-item measure when compared to accelerometer output.[23] Most correlations presented in that review were in the range of 0.2 to 0.4, indicating that longer questionnaires are not necessarily more valid than short ones when compared to accelerometer data. Another review reported a mean correlation of 0.37 and a range

between -0.71 and 0.98 with higher mean correlations in studies including men only (r=0.47) than in studies including women only (r=0.36).[24]

We found that validity of the single-item measure was better in women than in men. This finding was not reported by Milton et al [10], however correlation coefficients also differed by region and were lower in the oldest age group (55-64 years) when compared to GPAQ.[10] Differences in correlation coefficients observed between the different language regions in the present study were unexpected as translation and cultural adaptation was carried out according to the guidelines published by the IPAQ team.[17] However, it is also possible that these results were influenced by differences in social desirability reported for the different language regions in Switzerland,[25] or by differences in physical activity and sedentary behaviour such as more sitting time in younger adults as reported by others. [26]

The lower correlations reported in older adults support the difficulty of assessing physical activity in this population group based on instruments developed for middle-aged and younger adults. The weak but apparent correlation with light activities (r=0.27) supports the fact that older people may spend more time in light activities [8] and since light activities may have been included in the single-item measure, this may reflect difficulties for older adults in judging the intensity of different activities.[27] Another study assessing the validity of a single-item measure in older individuals found Spearman correlations of between 0.04 and 0.33.[28] However, only convergent and discriminant validity were investigated based on physical functioning and health status variables and no comparison with other physical activity measures such as accelerometers or questionnaires was reported.

Figure 2 illustrates the differences in measurement properties according to sub groups. In all sub groups, individuals tended to over-report the number of active days in the lower activity range (0-2 days according to accelerometer data) and to under-report them in the higher activity range. However, both over- and underreporting were more pronounced in men and in German-speaking individuals compared to women and individuals from the French- and the Italian-speaking part. Compared to individuals aged 40-64 years, older individuals generally over-reported the number of active days in the whole activity range. This is probably due to the different perception of physical activity intensities in different age groups.

Despite the fact that we did not use a population-representative sample, differences in physical activity behaviour between gender, age groups and language regions were similar to results found in other studies. A large Norwegian study measuring physical activity objectively found similar age and gender differences regarding time spent in sedentary, light and moderate-to-vigorous activities.[29] In Switzerland, these differences between language regions are commonly reported, also based on self-reported physical activity measures.[30, 25]

Strengths of the present study are the large sample size, the wide age range and the possibility to stratify the analyses by language region. Furthermore, accelerometers to assess physical activity objectively were used as criterion for the validity analyses.

A limitation is that one third of the sample was a convenience sample. Furthermore, the single-item measure only includes activities performed for at least 30 minutes a day. It is not possible to calculate total physical activity from the single-item measure as the duration of activity is not assessed so that its potential use is for surveillance or broad classification of exposure in epidemiological studies. Moreover, there is no information regarding domains and context of the reported activities. An advantage is that the single-item measure reflects the physical activity guidelines of adhering to 30 minutes or more of physical activity on five or more days a week which are used in different countries such as Switzerland. However, other countries such as the US and Canada have revised their guidelines recommending 150 minutes per week and not 30 minutes on at least 5 days per week. Finally using cut-off points for moderate activity based on accelerometer data of ≥2020 counts/minute may not be appropriate for older adults because older adults may perceive activities resulting in lower counts/minute as moderate.

Conclusions

With moderate correlations in all participants, the single-item measure performed similar or better than other short physical activity questionnaires. Furthermore, the results are in line with the correlation coefficients reported when comparing the English version of the single-item measure to accelerometer data.[13] Considering the acceptable validity and the short format of the single-item measure, it has a great potential to be included in large surveys. Even though the validity differs between men and women, different age groups and different language groups, it is acceptable in all subgroups. However these differences indicate that factors such as gender, age and socio-cultural background should be taken into account when developing physical activity questionnaires and also in future validation studies.

What are the new findings

- Criterion validity of the single-item physical activity measure in three languages was as good as or better than reported for other physical activity questionnaires and similar to that reported for the English version with Spearman correlations between 0.40-0.54.
- Correlations differed for men and women, different age groups and individuals from different language regions, which should be taken into account when developing physical activity questionnaires and in future validation studies.

- Correlations were moderate in all sub groups indicating that the single-item measure is a valid tool for use in these subgroups.

How might it impact on public health practice in the near future

- Large epidemiological studies and population surveys requiring information on physical activity behavior may want to include the single-item questionnaire now available and validated in four languages (English, German, French, Italian).
- Future validation studies on other physical activity questionnaires should take into account gender, age and language region.
- When developing a new physical activity questionnaire, factors such as gender, age and language should be taken into account.

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Competing interests

The authors have no competing interests.

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Contributor statement

MW was involved in the study design, data assessment, data analyses and in writing the paper. NP-H was involved in the study design, in the discussion of results and in writing the paper. SK was involved in the study design, in the discussion of results and in writing the paper. FM was involved in data assessment and in writing the paper. AB was involved in the discussion of results and in writing the paper. BWM was involved in the study design, in the discussion of results and in writing the paper.

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Figure 1. Scatter plot (with frequency weights) and linear regression line for comparison of single-item measure and accelerometer data for whole study sample

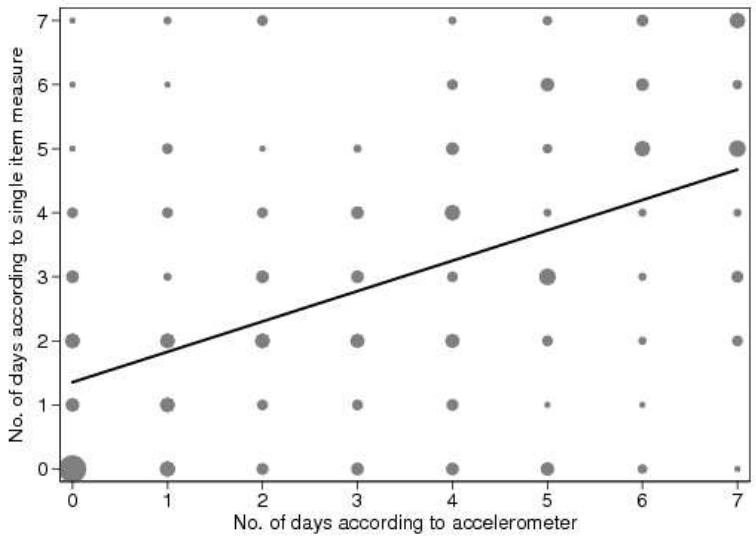

Figure 2. Linear regression lines for comparison of single-item measure and accelerometer data, by sub groups